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for

ELECTRICAL ADAPTER FOR PROTECTING ELECTRICAL INTERFACES

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ELECTRICAL ADAPTER FOR PROTECTING ELECTRICAL INTERFACES

RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Application Serial No. 60/422,204, filed October 29, 2002 and entitled "ELECTRICAL INTERFACE ADAPTER FOR TRANSCEIVER AND TESTER EVALUATION BOARD," which application is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

1. The Field of the Invention

[0002] The present invention relates generally to electrical adapters for protecting electrical connections of various electrical devices and/or optoelectronic devices, such as transceivers, transponders, and transmitters. More particularly, the present invention relates to an electrical adapter than can be placed between an electrical and/or optoelectronic device and a testing device which prolongs the life of the electrical interface on the electrical/optoelectronic device and/or testing device which may have fragile electrical interfaces.

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2. The Relevant Technology

[0003] The electrical interfaces of many electrical and/or optoelectronic devices are quite strong, able to withstand large numbers or insertions and removals to and from the complementary interfaces of other devices. However, some electrical interfaces, such as the OIF99.102.8, are more fragile. The OIF99.102.8 interface is composed of small pins known as leaves and blades. The female side of the connector contains leaves. Each leaf is a pair of pins that act together as a spring-like mechanism for holding a "blade" of a

complementary interface. Each blade is a single pin, slightly wider and shorter pin than the individual pins of the leaves. Each blade is designed to fit between a pair of leaf pins.

[0004] The leaves of such interfaces are typically more easily bent or damaged than the blades. A "lifetime" rating may be associated with the female side of the interface, indicating the number of insertions and removals the female side of the interface is likely to withstand before at least one leaf is damaged, making the interface unusable. For instance, the female side of the interface may have a lifetime rating of as few as 30 insertions and removals, indicating that most interfaces will withstand at least 30 insertions and removals, although some may fail after fewer insertions and removals.

[0005] When transceivers, transponders, and transmitters are expensive, the limited life of the electrical interface can result in a significant waste of resources. Because the electrical interface is often the first thing to break, an otherwise fully functional transponder may require expensive repair or may need to be replaced entirely when the only defect in the transceiver, transponder, and transmitter is a broken electrical interface.

[0006] During manufacturing, most optoelectronic devices, including transceivers, transponders, and transmitters, are made with electrical interfaces that are able to withstand the maximum number of insertions and removals that can be expected of electrical interfaces with pins that are small and fragile by nature. However, as a matter of statistics, it is inevitable that some electrical interfaces will be manufactured with pins that will break particularly easily, thus rendering the optoelectronic device unusable after a relatively few number of insertions and removals. For optoelectronic devices with these particularly fragile interfaces, the ability to reduce the total number

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of insertions and removals required to use the optoelectronic device may result in a significantly longer life for the device.

[0007] A similar problem arises with testers. Electrical interfaces of testers are typically less fragile than those of transponders and transceivers, but they nevertheless have a limited lifetime in terms of insertions and removals. As a result, a tester may be used to test a limited number of transponders before the electrical interface on the tester's evaluation board will likely break. When a tester, or the evaluation board of the tester, is particularly expensive, the result is that expensive repair or replacement costs may need to be incurred in order to fix an otherwise fully functional tester or evaluation board.

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SUMMARY OF THE INVENTION

[0008] In summary, the present invention is an electrical adapter designed to reduce the wear and tear on electrical and/or optoelectronic devices having fragile electrical interfaces. By securing the fragile electrical interface of an electrical/optoelectronic device to a relatively inexpensive electrical adapter with an electrical interface corresponding to that of the device, and then connecting the electrical adapter to multiple testers, the number of insertions of the electrical interface of the electrical/optoelectronic device is reduced to just one insertion. The wear and tear on the electrical interface of the device is thereby reduced.

[0009] As used herein, the term "electrical device" includes "optoelectronic devices" and, thus, the two terms may be used interchangeably. While optoelectronic devices include optical components as well as electrical components, for purposes of this specification and claims, optoelectronic devices are a subgroup of the broad category of electrical devices, because the electrical adapter is used with the electrical components of the optoelectronic device. Thus, for purposes of this specification, an optoelectronic device will be used in exemplary embodiments, although it will be understood that the electrical adapter may be used for any other electrical device.

[0010] The electrical adapter includes a board having first and second planar surfaces, a male electrical socket coupled to the first planar surface of the printed circuit board and a female electrical socket coupled to the second planar surface of the printed circuit board. The male electrical socket of the adapter is suitable for temporary connection to a female electrical interface of a first electrical device, and the female electrical socket is suitable for temporary connection to a male electrical interface of a

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second electrical device. The board includes electrical connections coupling the male and female electrical sockets.

[0011] In another aspect of the invention, a method is provided for testing an electrical device having an electrical interface. An electrical adapter is temporarily connected to the electrical interface of the electrical device. While maintaining the temporary connection of the electrical adapter to the electrical interface of the electrical device, the electrical device is coupled to a tester by coupling a second electrical interface of the adapter to a complementary electrical interface of the tester. Using the tester, a test is performed on the electrical device, then the electrical device is disconnected from the tester by disconnecting the electrical interface of the electrical adapter from the electrical interface of the tester. While maintaining the temporary connection of the electrical adapter to the electrical interface of the electrical device, the processes of connecting, testing, and disconnecting are repeated for a plurality of distinct testers.

[0012] In yet another aspect of the invention, a method is provided for preserving the electrical interface of a tester. An electrical adapter is temporarily connected to an electrical interface of the tester. While maintaining the temporary connection of the tester to the electrical adapter, the tester is coupled to an electrical device by coupling a second electrical interface of the electrical adapter to a complementary electrical interface of the electrical device. The electrical device is then tested using the tester. The tester is then disconnected from the electrical device by disconnecting the electrical interface of the electrical adapter on the tester from the electrical interface of the electrical adapter of the electrical device. While maintaining the temporary connection of the electrical adapter to the electrical interface of the tester, the processes of

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connecting, testing, and disconnecting are repeated for a plurality of distinct electrical devices.

[0013] These and other advantages and features of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0014] To further clarify the above and other advantages and features of the present invention, a more particular description of the invention will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope. The invention will be described and explained with additional specificity and detail through the use of the accompanying drawings, in which:

[0015] Figure 1 illustrates is a schematic top view of a transceiver or transponder;

[0016] Figure 2A is a schematic top view of an electrical adapter;

[0017] Figure 2B is a schematic bottom view of the electrical adapter shown in Figure 2A;

[0018] Figure 2C is a side view of the electrical adapter shown in Figure 2A;

[0019] Figure 3 is a top view of a spacer for use with the preferred embodiment;

[0020] Figure 4A is a side view of an electrical adapter of Figures 2A, 2B, and 2C being coupled to the transceiver of Figure 1;

[0021] Figure 4B is a side view of an electrical adapter of Figures 2A, 2B, and 2C coupled to the transceiver of Figure 1;

[0022] Figure 4C is a side view of a coupled transceiver and electrical adapter being coupled to a tester;

[0023] Figure 4D is a side view of a transceiver, an electrical adapter, and tester coupled to one another;

[0024] Figure 4E is a side view of a transceiver, electrical adapter, tester, and spacer coupled to one another;

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[0025] Figure 5A is a side view of a transceiver and a first electrical adapter being coupled to a second electrical adapter and a tester;

[0026] Figure 5B is a side view of a transceiver, first electrical adapter, second electrical adapter, and tester coupled to one another;

[0027] Figure 6 is a flow chart of a method for testing an electrical device having an electrical interface; and

[0028] Figure 7 is a flow chart of a method for testing electrical devices using a tester.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] The present invention provides an inexpensive electrical adapter used to reduce damage to an electrical interface of an expensive electrical device and/or optoelectronic device. As used herein, the term "electrical device" includes "optoelectronic devices" and, thus, the two terms may be used interchangeably. While optoelectronic devices include optical components as well as electrical components, for purposes of this specification and claims, optoelectronic devices are a subgroup of the broad category of electrical devices, because the electrical adapter is used with the electrical components of the optoelectronic device. Thus, for purposes of this specification, an optoelectronic device will be used in exemplary embodiments, although it will be understood that the electrical adapter may be used for any other electrical device.

[0030] When used, an electrical/optoelectronic device's electrical interface is typically inserted into and removed from corresponding and opposing gender electrical interfaces on other devices numerous times. These repeated insertions and removals can damage the fragile electrical interface of the electrical/optoelectronic device. By connecting an electrical adapter to the electrical/optoelectronic device, the coupled adapter and electrical/optoelectronic device can be repeatedly coupled to another device while only damaging the electrical interface of the inexpensive adapter.

[0031] Figure 1 is a schematic top view of a transceiver or transponder (hereafter "transceiver"). The transceiver 100 is any standard operating transceiver or transponder, such as the Integrated DWDM Transponder for OC-192/STM-64 with FEC or 10GbE. The transceiver includes an optical interface 104 for receiving information sent to the transceiver 100 as well as an electrical socket 132 for connecting the transceiver to

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electrical devices having corresponding and opposing gender electrical interfaces. The electrical socket 132 typically includes pins 134 configured to be inserted into another electrical interface having an opposing gender. The electrical socket 132 is preferably keyed with a key 136 so that only a complementary electrical interface having a complementary key and oriented in a single direction may be coupled to it.

[0032] Figure 2A is a schematic top view of an electrical adapter. Figure 2B is a schematic bottom view of the electrical adapter shown in Figure 2A. Figure 2C is a side view of the electrical adapter shown in Figure 2A.

[0033] The adapter 110 includes a generally planar board member 110 having first and second planar surfaces. Adapter 110 also includes an electrical interface 112 on one side of the board and an opposing electrical interface 114 on the opposing side of the board. The board member 110 may be any suitable material which provides sufficient strength to support electrical interfaces 112, 114. In one embodiment, the board member 110 is a printed circuit board (e.g., silicon material). Board member 100 provides an electrical connection for interfaces 112 and 114. A piece of metal or plastic may be used to support the board member 100.

[0034] The electrical interfaces 112, 114 are electrically coupled together using features of the planar member of the adapter 110. Electrical interface 112 and/or 114 is configured to electrically couple to the corresponding socket 132 of an external electrical devices, such as transceiver 100. Like the electrical socket 132 of the transceiver 100, the electrical interfaces 112 and/or 114 of the adapter 110 are keyed 120 and/or 122 so that only an interface having a corresponding gender may be coupled with it.

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[0035] In the embodiment of Figure 2A and 2B, the electrical interface 112 forms a male socket and the electrical interface 114 forms a female socket. That is, electrical interface 112 includes pins 116 in the form of blades, which form a male interface. In contrast, the electrical interface 114 includes pins 118 in the form of leaves, which form a female interface. Each leaf is a pair of pins 118 that act together as a spring-like mechanism for holding a "blade" of a complementary interface. Each blade is a single pin 116, slightly wider and shorter than the individual pins 118 of the leaves. Each blade is designed to fit between a pair of leaf pins 118. The electrical interfaces 112, 114 can be formed on printed circuit board 110 by means understood to those skilled in the art.

[0036] It will be appreciated that the orientation of male socket 112 and female socket 114 on adapter 110 may be varied so that the female socket 114 is on top and the male socket 112 is on the bottom of adapter 110. The pins 116, 118 of adapter 110 are electrically coupled. In one embodiment, pins 116, 118 are electrically coupled, for example, in one embodiment, through their ball grid array to metal traces formed on one or both planar sides of board 110.

[0037] Figure 3 is a spacer 140 having a generally planar body. Each spacer 140 includes an aperture 142 formed in the body through which an electrical interface or socket 132 (Figure 1), 112 (Figure 2A), 114 (Figure 2B), or 220 (Figure 4C) of a transceiver 100 (Figure 1), adapter 110 (Figure 2A), or evaluation board 210 (Figure 4C) of a tester 200 (Figure 4C) will fit. Further details of use of the spacer 140 and tester 200 are described below.

[0038] Figure 4A illustrates a side view of an electrical adapter of Figures 2A, 2B, and 2C being coupled to the transceiver of Figure 1, and Figure 4B shows a view of

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these pieces after coupling. In Figure 4C, these pieces are being coupled to a tester. Figure 4D illustrates the electrical adapter, transceiver, and tester all coupled together. As shown in Figure 4A, an electrical adapter 110 is inserted into a transceiver 100 by coupling the electrical interface 112 of an adapter 110 to the complementary and opposing gender electrical socket 132 (Figure 1) of a transceiver 100. This coupling is generally indicated by the arrows.

[0039] In Figure 4B, a transceiver 100 and an adapter 110 are shown coupled together after insertion. Coupled transceiver 100 and adapter 110 are then preferably inserted into an evaluation board 210 of a tester 200, as shown in Figure 4C, to obtain the configuration shown in Figure 4D. In some instances, as shown in Figure 4E, a spacer 140 may be used in order to provide support for the electrical adapter 110 and transceiver 100 by positioning the spacer 140 between the electrical adapter 110 and the evaluation board 210. When a spacer 140 is used, an electrical socket 220 (Figure 4C) of the evaluation board 210 is coupled to an electrical interface 112 of an adapter 110 inside the opening 142 of the spacer 140.

[0040] Figure 5A is a side view of a transceiver and a first electrical adapter being coupled to a second electrical adapter and a tester. To reduce damage to the electrical socket 220 (Figure 4C) of the evaluation board 210 of the tester 200, as well to prevent damage to the electrical socket 132 of a transceiver 100, two adapters, first adapter 110 and second adapter 130, may be used, as is shown in Figure 5A. Second adapter 130 is preferably identical to the first adapter 110 in all respects. In this case, the first electrical adapter 110 is coupled to a transceiver 100 as shown in Figures 4A and 4B. A second electrical adapter 130 is then coupled to the evaluation board 210 of the tester 200 by coupling the electrical interface 114 (Figure 2B) of the adapter 110 to the electrical

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socket 220 (Figure 4C) of the evaluation board 210 of the tester 200. Once coupled, the second electrical interface 114 (Figure 2B) of the first adapter 110 is then coupled to the complementary electrical interface 116 (Figure 2A) of the second adapter 130. The tester 200, transceiver 100, and two adapters 110 and 130 will then be configured as shown in Figure 5B.

[0041] Figure 6 is a flow chart of a method for testing an electrical device 100 (Figure 1) using an adapter 110 having an electrical interface 112 (Figure 2A) and/or 114 (Figure 2B). Through the use of a single connection of an electrical interface 112 of an adapter 110, shown in Figure 2A, to a corresponding electrical socket 132 of, for example, a transceiver 100, damage to an electrical socket 132 of a transceiver 100 or other electrical device may be reduced considerably.

[0042] At step 300, an electrical adapter 110 (Figures 4A and 4B) is temporarily connected to an electrical socket 132 (Figure 1) of an electrical device 100 (Figure 1). At step 310, electrical device 100 (Figure 1) is then connected to tester 200 (Figure 4C) by coupling the electrical adapter 110 (Figure 4C) to the electrical socket 220 (Figure 4C) of the tester 200 (Figure 4C). The second electrical interface 114 (Figure 4B) of the adapter is coupled to tester 200 (Figure 4C). At step 320, a test is then performed on the electrical device 100 (Figure 4C) using the tester 200 (Figure 4C). The electrical interface 114 (Figure 2B) of the electrical adapter 110 (Figure 4A) is then disconnected from the electrical socket 220 (Figure 4C) of the tester 200 (Figure 4C). Lastly, at step 330, the three steps 300, 310, and 320 are repeated for a variety of testers.

[0043] Figure 7 is a flow chart of a method for testing electrical devices 100 (Figure 1) using a tester (Figure 4C). Through the use of a single connection of an electrical interface 114 (Figure 2B) of an adapter 110 (Figure 4C) to a corresponding electrical

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socket 220 (Figure 4C) of an evaluation board 210 (Figure 4C) of a tester 200 (Figure 4C), damage to electrical socket 220 (Figure 4C) of an evaluation board 210 (Figure 4C) of a tester may be reduced considerably.

[0044] At step 360, an adapter 110 (Figure 4C) is connected to an electrical socket 220 (Figure 4C) of an evaluation board 210 (Figure 4C) of a tester 200 (Figure 4C). At step 370, the tester 200 (Figure 4C) is then connected to an electrical device 100 (Figure 4C) by temporarily coupling one of the electrical interfaces 112 (Figure 2A) or 114 (Figure 2B) of the electrical adapter 110 (Figure 4C) to an electrical socket 132 (Figure 1) of the electrical device 100 (Figure 4C). At step 380, a test is then performed on the electrical device 100 (Figure 4C), then the electrical device 100 (Figure 4C) is disconnected from the tester 200 (Figure 4C) by disconnecting the electrical interface 112 (Figure 2A) of the electrical adapter 110 (Figure 4C) from the electrical interface 134 (Figure 1) of the electrical device 100 (Figure 4C). Lastly, at step 390, the steps 360, 370, and 380 are repeated for a variety of testers.

[0045] As such, methods are provided for testing a particular electrical device against a plurality of distinct testers. The adapter is connected to a particular electrical device and temporarily connected a plurality of testers to run different tests on the same electrical device without damaging the pins or electrical connection of the particular electrical device. Thus, the electrical device, after the series of testing, is provided with longer lifetime rating.

[0046] Similarly, methods are provided for using a tester with a plurality of distinct electrical devices. That is, the adapter can be connected to a single tester and temporarily connected to a plurality of different electrical devices to run the same test

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on a large number of devices without damaging the pins or electrical connection of the single tester.

[0047] The adapters of the present invention are useful to test an electrical device regardless of the lifetime rating of the device. However, the present invention is useful for those the electrical devices having low lifetime ratings, e.g., less than 100 insertions and removals from corresponding complementary electrical interfaces on external electrical devices.

[0048] The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

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